Regional knowledge bases and territorial dynamics of industries

a comparison of biotech, ICT and automotive industries across Europe

Christophe Carrincazeaux, Frédéric Gaschet
GRETHA
University of Bordeaux & CNRS
France

RSA conference, PECS, 24-26 of May 2010

Introduction

- The main purpose of the paper : the importance of the regional knowledge base for local knowledge dynamics of industries
  - A crucial role of regions in shaping the "knowledge economy"
    - A growing literature emphasizes the critical role of regions in fostering new knowledge absorption, creation and dissemination across firms and organisations at the local level…
    - …with policy implications : the Lisbon agenda and regional policy
  - Is this true for all regions and industries ?
    - Copying with more diversity in regional trajectories and knowledge dynamics of industries
      - Knowledge intensive regions are not necessarily conducive for growth in all industries
      - Some industries can exhibit knowledge dynamics less sensitive to regional contexts
    - Which regional configurations stimulate knowledge creation in specific industries ?
- Two main investigations (EURODITE project) :
  - 1) Explaining local dynamics of industries: the interplay of regional and sectoral knowledge bases
    - Characterizing regional knowledge bases in Europe and looking to their ability to support knowledge dynamics in some industries
  - 2) A typology of Territorial Knowledge Dynamics according to role of the regional knowledge base
    - A typology crossing the spatial configuration of industries, regional knowledge bases and compositeness of knowledge dynamics
    - Application to 16 case studies from Biotech, ICT/Nanotech/Photonics and Automotive

I - The impact of regional knowledge bases : the role of sectoral contexts

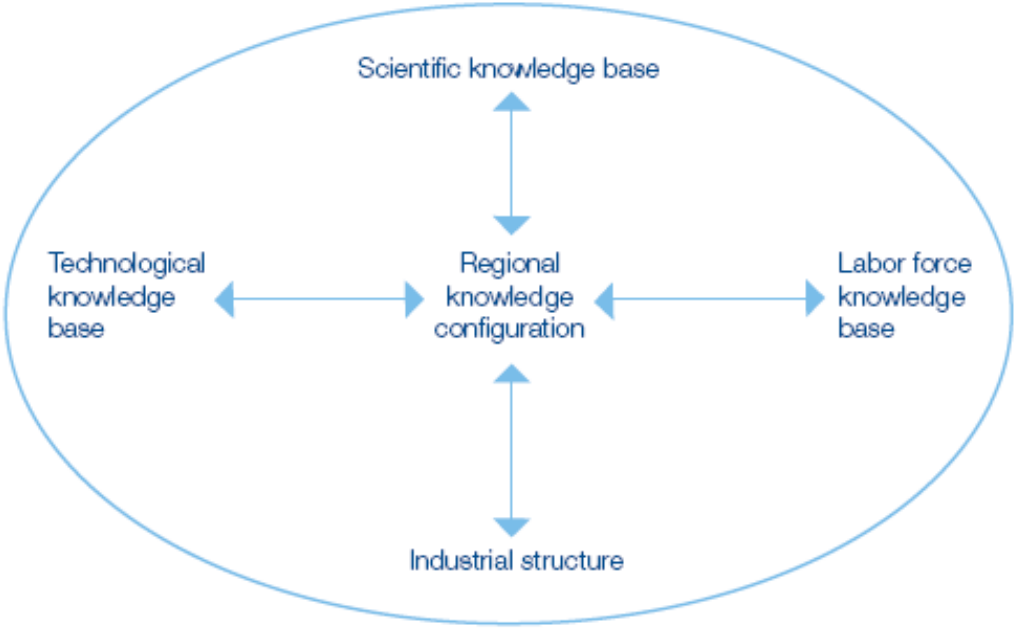
- Three main steps
  - Defining the knowledge base of regions
    - Diversity versus intensity
    - Multiscalar definition : incompleteness of regional « systems »
  - Knowledge intensity and regional growth : a missing link
  - Understanding the local dynamic of industries: the interplay of regional and sectoral knowledge bases

1) The impact of regional knowledge bases : the role of sectoral contexts

Defining Regional knowledge bases

- Characterizing Regional knowledge bases
  - Limits of the RIS approach (Cooke,1998, Asheim &Coenen, 2005) focusing only on the governance structure
  - Identification of regional "configurations" under the hypothesis of complementarity between four components
  - Principal component analysis to identify complementarities: main indicators associations among regions
  - Cluster analysis to group regions around these complementarities: "knowledge configurations"

Regional knowledge configurations – Key dimensions.



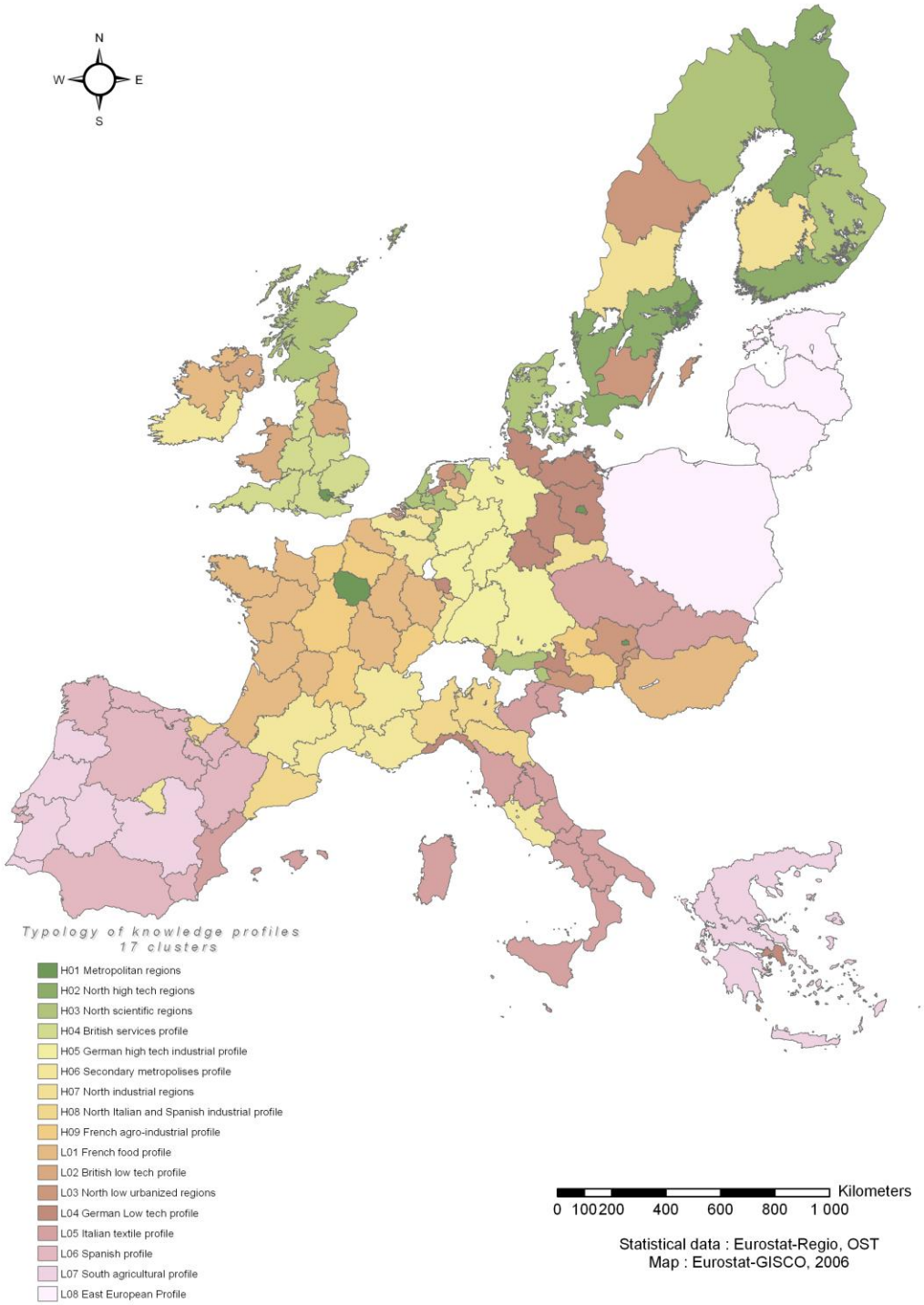
Regional Knowlegde bases differ in their structural properties, not only by knowledge intensity

- Macro differences of knowledge intensity but diversity of regional configurations sharing the same overall "intensity"
  - Resulting in 17 clusters of regions from UE25
  - Distinctive combinations of knowledge resources
    - British profile : KIBS/education
    - German profile : complementarity industry/technology
    - North scientific regions : science push model
    - North High tech : complementarity science /technology

Regional knowledge bases remain shaped by national institutional settings

- a strong national dimension of such regional configurations
- Except some Cross national Metropolitan profiles
  - Intensive knowledge capitals (London, Paris, Stockholm, Berlin…)

Knowledge intensity	Regional knowledge configuration
Knowledge intensive profiles	01 Metropolitan regions
	02 North high tech regions
	03 North scientific regions
	04 British services and educational profile
	05 German high tech industrial profile
Medium tech intermediary profiles	06 Secondary metropolises regions
	07 North industrial regions
	08 North Italian and Spanish industrial regions
	09 French agro-industrial profile
Low tech intermediary profiles	01 French food profile
	02 British low tech profile
	03 North low urbanised regions
	04 German low tech profile
Low tech profiles	05 Italian textile profile
	06 Spanish profile
	07 South agricultural profile
	08 East European profile



Knowledge intensity and regional growth : a missing link ?

- **No clear relationship** between knowledge intensity and (**even relative**) performances
  - Knowledge intensive regions clearly associated with a «intensive growth regime » :
    - ➔**Metropolitan effect** (economic growth but unemployment)
  - Other profiles conducive for growth (but with high heterogeneity)
    - ➔« **convergence regions** » (Spain, Ireland)
    - ➔**Traditional industrial regions** (Italian, Spanish)

Regional knowledge configurations fail to exhaustively explain regional performances, except a metropolitan effect

The interplay of regional and sectoral knowledge bases

- A major hypothesis
  - local growth and change of an industry is mainly the result of a sufficient level of coherence between the regional knowledge configuration and the sectoral knowledge context
    - specific regional configurations may only support specific sectoral knowledge accumulation patterns
- Connecting sectors and regional knowledge bases : existing approaches
  - Evolutionary perspective
    - sectoral systems of innovation and production Malerba (2002, 2005)
    - Spatialization of the concept of technological regime (Breschi, 2000)
  - Institutional and knowledge perpsective
    - Identification of three main cross-sectoral knowledge bases, broadening the approach both from traditionally defined sectors and from a technological perspective: synthetic, analytical and symbolic knowledge bases (Asheim, 2007; Cooke, 2006)
    - Attempts to correlate knowledge base of industries and the nature of regional innovation systems
      - Asheim (2007) proposed to cross the nature of knowledge bases and the type RIS governance structure
      - Asheim and Coenen (2005) : regional knowledge infrastructure is crucial only for industries drawing on a analytical knowledge base
      - Coenen et al. (2006) : A similar demonstration when comparing spatial patterns of innovation in a biopharmaceutical and a agro food-biotech clusters

1) The impact of regional knowledge bases : the role of sectoral contexts

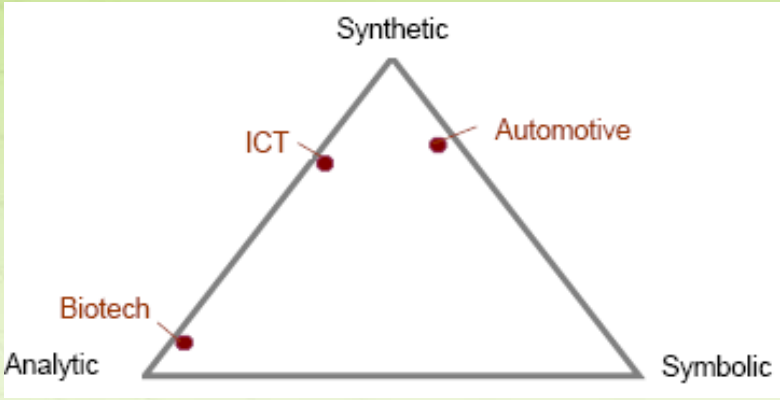
Types of regional innovation systems and knowledge bases following Asheim (2007)

Type of RIS	Type of knowledge: Analytical/scientific	Synthetic/engineering	Symbolic/creative
Embedded (grassroots RIS)		IDs in Emilia-Romagna (machinery)	'Advertising village' – Soho (London)
Networked (network RIS)	Regional clusters – regional university (wireless in Aalborg)	Regional clusters – regional technical university (mechanical in Baden–Württemberg)	Barcelona as the design city
Regionalized national (dirigiste RIS)	Science parks/ technopolis (biotech, IT)	Large industrial complex (Norwegian oil- and gas-related industry)	

Source: Asheim, 2007, p 234.

A quantitative view on territorial dynamics of industries in European regions

- Comparison of three EURODITE "sectors" : Biotech, ICT, automotive
  - Differentiated sectoral knowledge bases
  - Sectoral dynamic measured by variation of employment (automotive) or by the number of patents per inhabitant (Biotech, ICT)
  - Statistical tools to address two questions :
    - are there significant differences between regional knowledge configurations ?
    - Do sectoral knowledge accumulation patterns depend on specific knowledge ressources (Science, technology, education) ?



Regional configurations and dynamics of three industries

- Biotech
  - Strongly differentiated regional performances
  - A few « knowledge intensive » profiles exhibiting higher than mean performances in Europe :
    - Metropolitan regions
    - North high tech regions
    - North scientific regions
    - German high tech industrial profile
- ICT
  - Less differentiated regional performances
  - Over-Performing regions include
    - Some knowledge intensive configurations
    - But North traditional industrial regions too
- Automotive
  - Very low differentiation of regional performances
  - No visible impact of « knowledge intensive » profiles

Results: Anova model

	Biotech	ICT	Automotive
H01 Metropolitan regions	68,83***	436,51***	0,0022
H02 North high tech regions	29,26***	157,89*	-0,0597
H03 North scientific regions	34,87***	205,15**	-0,1141*
H04 British services	15,9	26,6	-0,095
H05 German high tech	46,73***	286,95***	MD
H06 Intermediary agro-scientific	13,9	96,3	-0,0706
H07 North Italian industrial regions	2,8	196,86***	0,0791
H08 Intermediary agro-industrial p	24,26***	109,6	0,123
H09 North traditional indus regions	2,7	17,0	0,046
L01 - French industrial food profile	9,0	30,9	0,4382**
L02 - British low tech profile	9,9	36,3	-0,1583*
L03 - North low urbanized regions	3,6	36,0	0,0457
L04 – German Low tech profile	1,7	11,8	-0,0042
L05 – Italian textile profile	1,1	0,8	MD
L06 – Iberian profile	1,6	9,4	0,0462
L07 – Greek agricultural profile	1,4	4,8	0,1325
general mean value	14,9	91,0	0,0531
F	7,93***	3,87***	2,05*
Partial Eta Squared	0,52	0,35	0,25

The dependence of sectoral dynamics on specific components of the regional knowledge base

	Components of the regional knowledge base			Industrial structure
	Scientific knowledge base	Technological knowledge base	Labour force knowledge base	
Biotech-level[1]	3,26***	4,82***	0,77	1,09
Biotech-variation[2]	1,72*	3,41***	4,09***	0,34
ICT-level[1]	2,26*	53,56***	0,95	0,04
ICT- variation[2]	0,42	0,71	2,06*	0,17
Automotive[3]	0,35	0,75	0,12	1,38

[1] Number of patents per capita (2003)
[2] Variation of number of patents (1999-2003)
[3] Variation of employment in % (1999-2003)

II - Compositeness of knowledge trajectories and territorial knowledge dynamics

Linking regional and sectoral knowledge bases in order to understand TKDs

- Extending approaches linking sectors and regional knowledge bases using the Eurodite framework
  - Regional knowledge configurations
  - Sectoral knowledge base
  - Increasing compositness of knowledge
- A grid for analysing Eurodite detailed TKDs studies

1) Limitations of existing approaches facing Eurodite results

3 main limitations for existing approaches

- an exclusive focus on technical change, whereas most of recent work on the economics of knowledge shows an increasing diversity of knowledge sources and processes
- the questionable stability of sectors' frontiers in the context of increasing combinatorial knowledge processes
- The framework appears to be too determinist in the sense that it would lead to identify a unique spatial regime for each sector

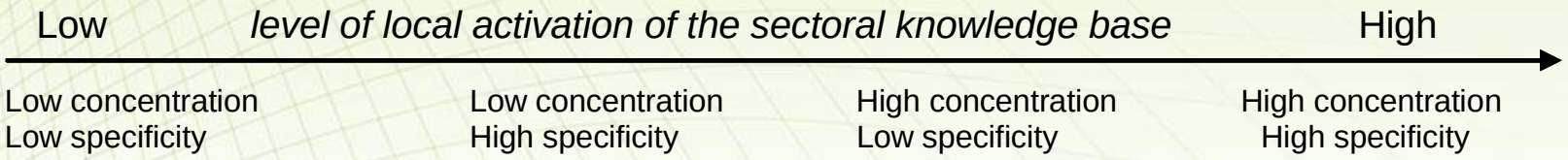
➔ Understanding sectoral spatial patterns vs understanding diversity of TKDs

Sectors in regions : the local activation of the sectoral knowledge base

Amount of specific resources locally available for firms :

- Specialisation and critical mass
- Knowledge specificity (cumulativeness, appropriability)

The level of local activation of the sectoral knowledge base : the interplay of concentration and specificity



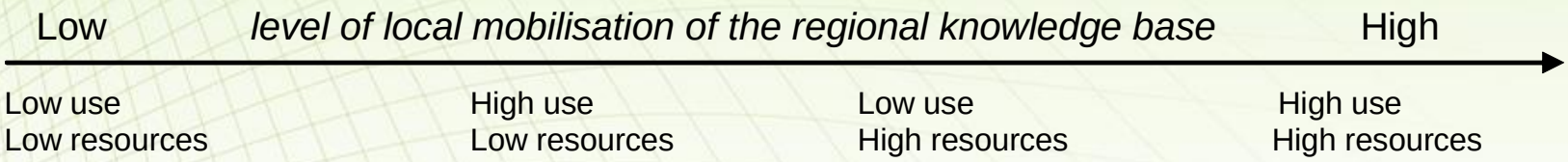
➔ Differentiated spatial regimes for a sector

Sectors in regions : the mobilsation of the regional knowledge base

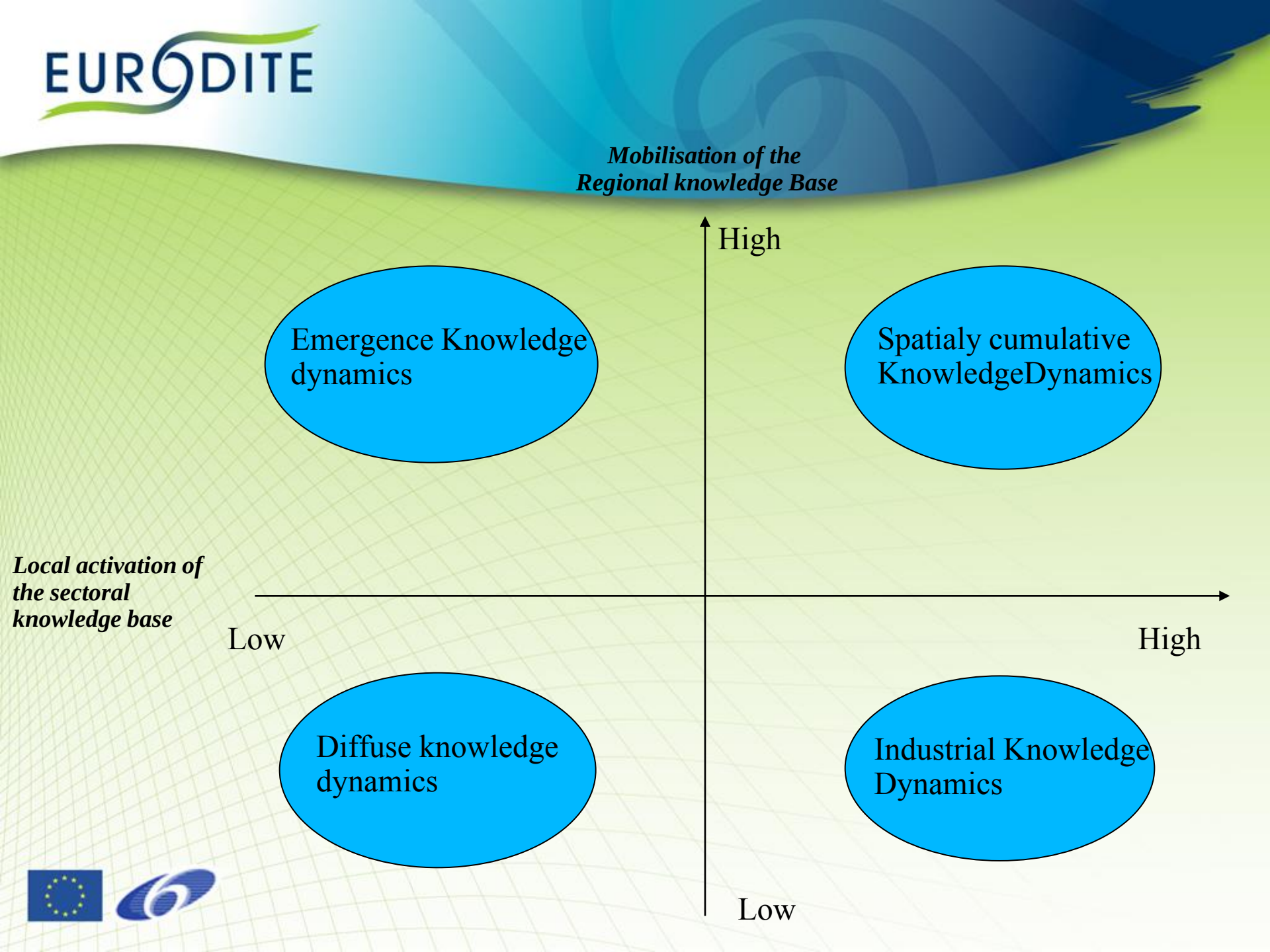
Amount of specific resources locally available for firms according to the scientific, technological and labour force knowledge bases:

- Relative availability of regional resources
- Effective use of regional resources

The level of local mobilisation of the regional knowledge base: potential resources and effective use of regional knowledge



➔ Differentiated spatial regimes for a sector


Mobilisation of the
Regional knowledge Base
High
Emergence Knowledge dynamics
Spatialy cumulative KnowledgeDynamics
Local activation of the sectoral knowledge base
Low
High
Diffuse knowledge dynamics
Industrial Knowledge Dynamics
Low

3) Step 2: introducing compositness

Growing role of compositeness (heterogeneity and fragmentation following Antonelli, 2006)

Between MAR and Jacobs externalities : related variety (Boschma, Frenken, 2008 for sectors; Dosi, Teece, Winter, 1994, at the firme level)

Related variety as one dimension of combinatorial knowledge dynamics:

- **Related variety**: intersectoral knowledge transfers in order to generate new knowledge
- **Knowledge modularity**: interactions between knowledge fields in order to ensure the compatibility of knowledge components
- **Transectoral knowledge fields**: compositeness arises from the exploration of a generic and transectoral knowledge
- **Internal developement of complementary knowledge** fields inside firms

3) Step 2: introducing compositness

		Knowledge phase (***Technological dimension***)	
		Exploration	**Integration/exploitation**
Intersectoral knowledge flows between firms ***(Intersectoral combinatorial dimension only)***	**Strong**	Related variety	Knowledge modularity
	Weak	Shared technological platform (GPT) – trans-sectoral knowledge fields	Internal development of complementary knowledge fields

Compositness is the third dimension to introduce in order to understand the diversity of territorial knowledge dynamics

Regional knowledge bases and territorial dynamics of industries

The diversity of territorial knowledge dynamics

Diversity based on :

1) Local links of the sector with the regional knowledge base

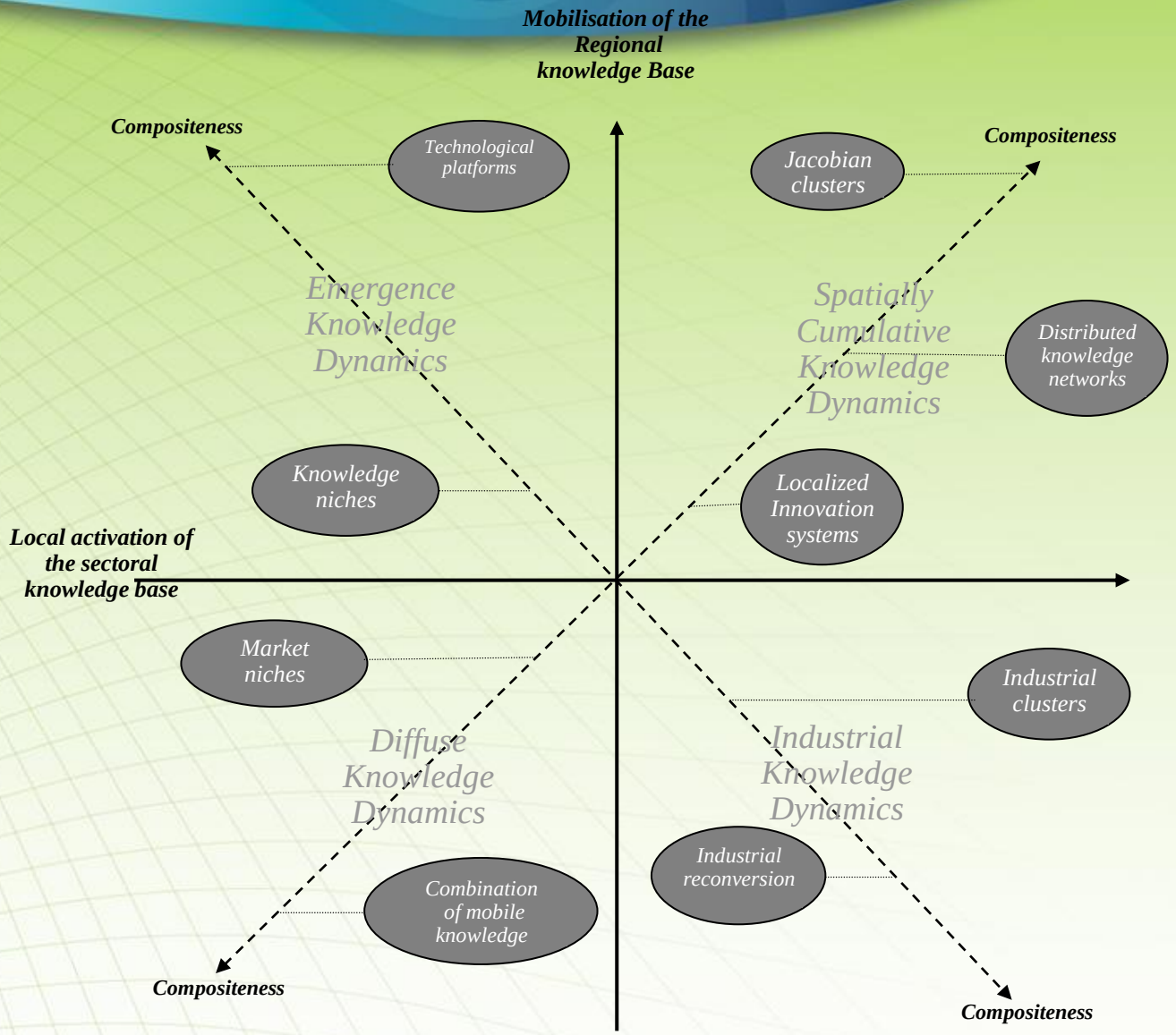
science,technology/innovation, labour force, KIBS, public bodies,…

2) Local intra-sectoral links

activation of the local sectoral knowledge base

3) Compositness of knowledge

Need to access local or distant sources of knowledge (inter-sectoral)



4) Step 3: An analysis of Eurodite TKDs' studies

Analysis of 12 case studies from EURODITE WP5

Studies related to three differentiated sectoral knowledge bases:

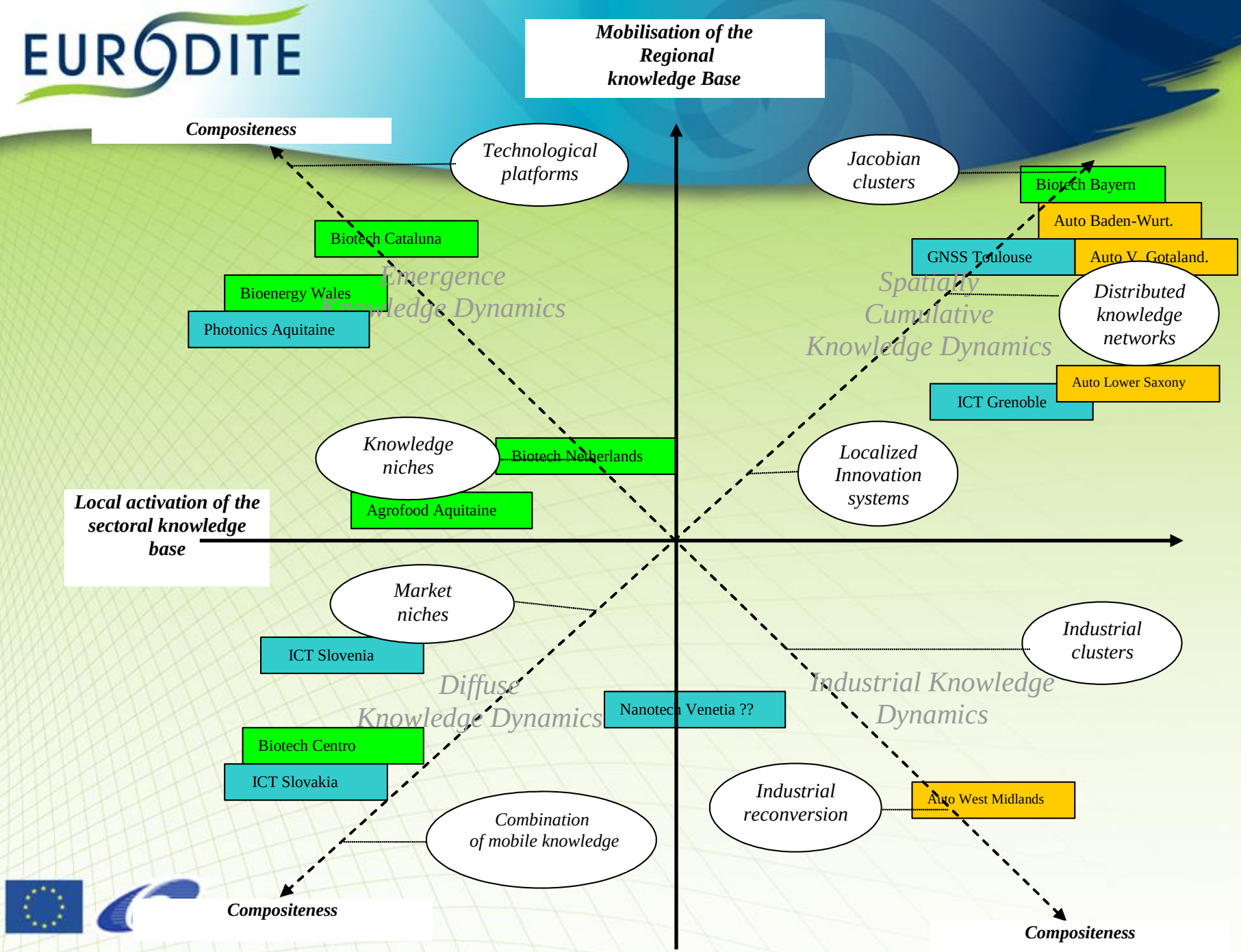
ICT, biotech and automotive industries

Biotech	ICT/nanotech/photonics	Automotive
Pharmaceuticals and biotech Bayern	GNSS cluster Midi-Pyrenées	Automotive industry and technical services Baden-Wurttemberg
Biotech and seed industry Nijmegen	ICT Slovenia	Automotive/Crash safety Vrästra Götaland
Pharmaceuticals and biotech Cataluña	ICT Grenoble	Automotive electronics and software engineering Lower saxony
Agro-food industy and biotech Aquitaine	Services in IT security Slovakia	Automotive West Midlands
Functional-food and biotech Wales	Photonic cluster Aquitaine	
Biotech cluster Centro	Nanotechnology cluster Venetia	

Case studies	Nature of the TKD	Type	1.Nature of the Knowledge phase/ knowledge base	2. Nature of local interfirms interactions	3-Interactions of local industries with the regional knowledge base	4-External inflows of knowledge
Pharmaceuticals and biotech Bayern	Important shift from cumulative in-house competencies to complementary (composite) knowledge through in-licensing.	Jacobian cluster	Exploration/examination From analytical (research on stem cells) to more synthetic (different compounds)	Important related variety (biotech, pharmaceuticals) with search of complementary knowledge (shift from in-house knowledge to external one).	Strategic collaborations with other firms and universities on the technological side are often local. High mobilisation of regional knowledge base (exploration/examination phase)	Very important through in-licensing. Links at different scales, mainly in the exploitation phase
Agro-food industy and biotech Aquitaine	Opportunities of crossing biotechnologies with local specialisation on agrifood industry.	Knowledge niches	From exploration to exploitation Analytic knowledge, but growing synthetic and also symbolic ones (functional food)	Small firms combining different pieces of knowledge internally. Low inter-firm collaborations. Small innovative firms, specialisation.	Strong local interactions with the scientific system, but difficulty to construct cooperation between pharmaceutical and agrifood sector. Poor firm R&D potential.	Existence of two types of external knowledge flows : on markets (non local ones) and on scientific cooperations. But mainly local links due to local personal networks.
Bioenergy and Agro-food in Wales	Creation of technological platforms aournd organic food and clean energy	Technological platform	All phases are present, more examination/exploitation in organic-food than in biofuel Analytical and symbolic knowledge dominates	Importance of local interactions and related variety	Regional knowledge base is of great importance related to biotechnologies	Combinatorial knowledge and multi-scalar actors. National norms

Case studies	Nature of the TKD	Type	1.Nature of the Knowledge phase/ knowledge base	2. Nature of local interfirms interactions	3-Interactions of local industries with the regional knowledge base	4-External inflows of knowledge
GNSS cluster in Midi-Pyrenées	Departure from the initial cumulative trajectory in aerospace and defence industries :towards exploration of differentiated opportunities of GNSS in various industries (in car navigation, wireless communication, GIS)	Jacobian cluster	Exploration phase Both analytical (fundamental knowledge from earth science) and synthetic (integration of different components, …)	Important related variety through R&S collaborative projects associating predominantly organisations with differentiated but complementary knowledge fields (knowledge heterophily)	Central role of two local research bodies (CNES, TESA) for thecoordination of other stockholders	Important and complementary to local ties Two global “pipelines” connecting to Germany and Italia
ICT in Grenoble	Incremental products innovation mainly through improved technological bricks related to mobile phones (Bluetooth, energy saving…°	Distributed knowledge network	KP: examination KB: Predominantly synthetic (engineering, combination of technological modules…)	Predominant manufacturing vertical links (role of leading big firms STmicroelectonics) Important related variety arising from the convergence between nanotechnologies, software and electronics	Weakness of knowledge interactions between firms (MNF/SME’s) and local research bodies Crucial importance of labour force qualification	Dominant geographically distant interactions to grasp knowledge bits from different locations
Photonic cluster in Aquitaine	Creation of spinoffs with specialised technological competences Exploitation of new technological opportunities for a large spectrum of final users (metrology, medical imagery, eye surgery…)	Technological Platform	Exploration/examination Predominantly analytical knowledge base (high power lasers, imagery)	Collaborative R&D and manufacturing networks involving local SMEs with highly complementary competences	Dominant links with local research institutions (CEA-CESTAS; CPMOH, CELIA) and technological transfer platforms (Alphanov, PICIN)	Knowledge flows from external research bodies (LULLI, Univ of Savoie, Kastler Lab…) through local scientific gatekeepers (CEA, CPMOH); Location of new research bodies (sup’optic) Attraction of new firms

Case studies	Nature of the TKD	Type of Territorial knowledge dynamic	1.Nature of the Knowledge phase/ knowledge base	2. Nature of local interfirms interactions	3-Interactions of local industries with the regional knowledge base	4-External inflows of knowledge
Automotive industry and technical services Baden-Wurttemberg	Changing competitive environment in a traditional sector. Role of engineering KIBS in the process of change in the division of labor	Jacobian cluster	All phases and forms of knowledge. Analytical and mainly synthetic knowledge, but growing importance of combinatorial knowledge	High interactions moving from cumulative to more combinatorial. Importance of related variety and combination of different technological fields. Growing symbolic knowledge. KIBS as interfaces between pieces of knowledge	High specialisation and cumulativness at the regional level. Lots of research centers and universities involved in the TKD. New knowledge combinations through KIBS	Knowledge is multi-scalar but spatial proximity is always very important. Distant links are organisationally mediated inside organisations or through KIBS
Automotive electronics and software engineering Lower saxony	Development of regional competences in automotive electronics and software engineering	Distributed knowledge network	All types of knowledge and phases. Need for external knowledge and combination (electronics)	Interactions are specific with high domination of the OEM. Local interactions develop recently with the need of outsourcing and access new knowledge. Some related variety (electronics, aeronautics). KIBS as interfaces	Very specific configuration in which one firm dominates the industrial structure and influence policy. More scientific collaborations needed. Changing dynamics to more activation of the regional knowledge base	Knowledge is multi-scalar. Proximity relations are complementary with more global ones.


Mobilisation of the Regional knowledge Base
Compositeness
Technological platforms
Jacobian clusters
Biotech Bayern
Auto Baden-Wurt.
GNSS Toulouse
Auto V. Gotaland.
Biotech Cataluna
Bioenergy Wales
Photonics Aquitaine
Emergence Knowledge Dynamics
Spatially Cumulative Knowledge Dynamics
Distributed knowledge networks
Auto Lower Saxony
ICT Grenoble
Knowledge niches
Biotech Netherlands
Agrofood Aquitaine
Localized Innovation systems
Local activation of the sectoral knowledge base
Market niches
ICT Slovenia
Industrial clusters
Diffuse Knowledge Dynamics
Industrial Knowledge Dynamics
Nanotech Venetia ??
Biotech Centro
ICT Slovakia
Industrial reconversion
Auto West Midlands
Combination of mobile knowledge
Compositeness
Compositeness

Some conclusions

- Differentiated territorial knowledge dynamics inside sectors
- Diversity of spatial trajectories
- Complementarity between local and non local relations
- Need for targeted policies

- Next step: evaluating performances